

IN THE CLAIMS:

Claim 1 (currently amended): A high pH aqueous based zirconium (IV) crosslinked guar fracturing fluid suitable for use in wells with bottom-hole static temperatures of 250°F or greater, comprising:

a polymer solution, comprising:

an aqueous fluid,

natural guar gum,

a stabilizer,

an non-delayed alkaline buffer, and

an alpha-hydroxycarboxylic acid gelation delaying agent; and

a zirconium (IV) crosslinking agent.

Claim 2 (original): The fracturing fluid according to claim 1, wherein the aqueous fluid comprises substantially any aqueous fluid that does not adversely react with one of the constituents of the fracturing fluid, the subterranean formation, and the fluids present therein.

Claim 3 (original): The fracturing fluid according to claim 1, wherein the aqueous fluid is selected from the group consisting of fresh water, natural brines, and artificial brines.

Claim 4 (original): The fracturing fluid according to claim 3, wherein the artificial brines are selected from the group consisting of potassium chloride solutions and sodium chlorides solutions.

Claim 5 (original): The fracturing fluid according to claim 1, wherein the stabilizer comprises any free-radical-scavenging compound.

Claim 6 (original): The fracturing fluid according to claim 1, wherein the stabilizer is selected from the group consisting of sodium thiosulfate, thiourea, urea, sodium sulfite, and methanol.

Claim 7 (currently amended): The fracturing fluid according to claim 1, wherein the non-delayed alkaline buffer comprises alkaline compounds.

Claim 8 (original): The fracturing fluid according to claim 7, wherein the alkaline compounds comprise one or more selected from the group consisting of ammonium and alkaline metal hydroxides, carbonates, and bicarbonates.

Claim 9 (original): The fracturing fluid according to claim 8, wherein the alkaline compounds are selected from the group consisting of sodium hydroxide, sodium carbonate, and sodium bicarbonate, and mixtures thereof.

Claim 10 (currently amended): The ~~mixed alkaline compounds~~ fracturing fluid ~~of~~ according to claim 9, wherein the ratio of carbonate to bicarbonate may range from about 8:2 to 2:8.

Claim 11 (currently amended): The fracturing fluid according to claim 1, wherein the alpha-hydroxycarboxylic acid gelation delaying agent comprises; an alpha-hydroxycarboxylic acid, the salt of an alpha-hydroxycarboxylic acid, or mixtures thereof ~~of an alpha-hydroxycarboxylic acid and salts of an alpha-hydroxycarboxylic acids~~.

Claim 12 (original): The fracturing fluid according to claim 11, wherein the alpha-hydroxycarboxylic acid or alpha-hydroxycarboxylic acid salt; is selected from the group consisting of citric acid, malic acid, glycolic acid, lactic acid, tartaric acid, gluconic acid, glyceric acid, mandelic acid, their salts and mixtures thereof.

Claim 13 (currently amended): The fracturing fluid according to claim 1, wherein the alpha-hydroxycarboxylic acid gelation delaying agent comprises an ammonium, amine, or alkali metal salt of an alpha-hydroxycarboxylic acid.

Claim 14 (original): The fracturing fluid according to claim 13, wherein the ammonium, amine, or alkali metal salt of an alpha-hydroxycarboxylic acid is selected from the group consisting of sodium citrate and ammonium lactate.

Claim 15 (original): The fracturing fluid according to claim 1, wherein the zirconium (IV) crosslinking agent comprises any zirconium compound capable of solubilizing in an aqueous polymer solution to release the metal so that gelation takes place under controlled conditions.

Claim 16 (original): The fracturing fluid according to claim 1, wherein the zirconium (IV) crosslinking agent is selected from the group consisting of an aqueous solution of a zirconium alpha-hydroxycarboxylic acid salt.

Claim 17 (original): The fracturing fluid according to claim 16, wherein the zirconium alpha-hydroxycarboxylic acid salt crosslinking agent is selected from the group consisting of zirconium ammonium lactate, zirconium di or tri ethanolamine lactate, zirconium diisopropylamine lactate, and zirconium sodium lactate salts.

Claim 18 (original): The fracturing fluid according to claim 16, wherein the complex of zirconium and an alpha-hydroxycarboxylic acid is selected from the group consisting of aqueous solutions of zirconium citrate, zirconium tartate, and zirconium glycolate.

Claim 19 (original): The fracturing fluid according to claim 1, wherein the zirconium (IV) crosslinking agent is selected from the group consisting of monoalkylammonium zirconium compounds, dialkylammonium zirconium compounds, and trialkylammonium zirconium compounds.

Claim 20 (original): The fracturing fluid according to claim 1, wherein the zirconium (IV) crosslinking agent is selected from the group consisting of a zirconium triethanolamine complex and a diethanolamine complex.

Claim 21 (currently amended): A method for formulating an aqueous based zirconium (IV) crosslinked guar fracturing fluid having a pH from about 9 to about 12, comprising the steps of:

placing an aqueous fluid into a suitable mixing device;

adding a stabilizer to the aqueous fluid in an amount from about 1 PPTG to about 50 PPTG of the aqueous fluid;

allowing the stabilizer to dissolve into the aqueous fluid for a first predetermined period;

adding natural guar gum to the mixture in an amount from about 10 PPTG to about 100 PPTG of the aqueous fluid;

mixing the mixture for a second predetermined period;

adding an non-delayed alkaline buffer to the mixture in an amount from about 1 PPTG to about 40 PPTG of the aqueous fluid;

mixing the mixture for a third predetermined period;

adding an alpha-hydroxycarboxylic acid gelation delaying agent to the mixture in an amount from about 0.25 PPTG to about 3.75 PPTG of the aqueous fluid;

mixing the mixture for a fourth predetermined period, thereby forming a polymer solution;

adding a zirconium (IV) crosslinking agent in an amount from about 0.1 PPTG to about 5 PPTG of the formulated polymer solution; and

mixing until gelation occurs, thereby producing the fracturing fluid.

Claim 22 (original): The method according to claim 21, wherein the aqueous fluid comprises substantially any aqueous fluid that does not adversely react with one of the constituents of the fracturing fluid, the subterranean formation, and the fluids present therein.

Claim 23 (original): The method according to claim 21, wherein the aqueous fluid is selected from the group consisting of fresh water, natural brines, and artificial brines.

Claim 24 (original): The method according to claim 23, wherein the artificial brines are selected from the group consisting of such as potassium chloride solutions and sodium chlorides solutions.

Claim 25 (original): The method according to claim 21, wherein the stabilizer comprises any free-radical-scavenging compound.

Claim 26 (original): The method according to claim 21, wherein the stabilizer is selected from the group consisting of sodium thiosulfate, thiourea, urea, sodium sulfite, and methanol.

Claim 27 (currently amended): The method according to claim 21, wherein the non-delayed alkaline buffer comprises alkaline compounds.

Claim 28 (original): The method according to claim 27, wherein the alkaline compounds comprise one or more selected from the group consisting of ammonium and alkaline metal hydroxides, carbonates, and bicarbonates.

Claim 29 (original): The method according to claim 28, wherein the alkaline compounds are selected from the group consisting of sodium hydroxide, sodium carbonate, and sodium bicarbonate, and mixtures thereof.

Claim 30 (currently amended): The method according to claim 21, wherein the alpha-hydroxycarboxylic acid gelation delaying agent comprises an alpha-hydroxycarboxylic acid, the salt of an alpha-hydroxycarboxylic acid, or mixtures thereof.

Claim 31 (original): The method according to claim 30, wherein the alpha-hydroxycarboxylic acid or alpha-hydroxycarboxylic acid salt is selected from the group consisting of citric acid, malic acid, glycolic acid, lactic acid, tartaric acid, gluconic acid, glyceric acid, mandelic acid, their salts and mixtures thereof.

Claim 32 (currently amended): The method according to claim 21, wherein the alpha-hydroxycarboxylic acid gelation delaying agent comprises an ammonium, amine, or alkali metal salt of an alpha-hydroxycarboxylic acid.

Claim 33 (original): The method according to claim 32, wherein the ammonium, amine, or alkali metal salt of an alpha-hydroxycarboxylic acid is selected from the group consisting of sodium citrate and ammonium lactate.

Claim 34 (original): The method according to claim 21, wherein the zirconium (IV) crosslinking agent comprises any zirconium compound capable of solubilizing in an aqueous polymer solution to release the metal so that gelation takes place under controlled conditions.

Claim 35 (original): The method according to claim 21, wherein the zirconium (IV) crosslinking agent is selected from the group consisting of an aqueous solution of a zirconium alpha-hydroxycarboxylic acid salt.

Claim 36 (original): The method according to claim 35, wherein the zirconium alpha-hydroxycarboxylic acid salt crosslinking agent is selected from the group consisting of zirconium ammonium lactate, zirconium di or tri ethanolamine lactate, zirconium diisopropylamine lactate, and zirconium sodium lactate salts.

Claim 37 (original): The method according to claim 35, wherein the complex of zirconium and an alpha-hydroxycarboxylic acid is selected from the group consisting of aqueous solutions of zirconium citrate, zirconium tartate, and zirconium glycolate.

Claim 38 (original): The method according to claim 21, wherein the zirconium (IV) crosslinking agent is selected from the group consisting of monoalkylammonium zirconium compounds, dialkylammonium zirconium compounds, and trialkylammonium zirconium compounds.

Claim 39 (original): The method according to claim 21, wherein the zirconium (IV) crosslinking agent is selected from the group consisting of a zirconium triethanolamine complex and a diethanolamine complex.

Claim 40 (currently amended): A method of hydraulically fracturing a subterranean zone penetrated by a wellbore, comprising ~~the steps of~~:

preparing an aqueous based zirconium (IV) crosslinked guar fracturing fluid having a pH from about 9 to about 12, comprising:

a polymer solution, comprising:

an aqueous fluid,

natural guar gum in an amount from about 10 PPTG to about 100 PPTG of the aqueous fluid,

a stabilizer in an amount from about 1 PPTG to about 50 PPTG of the aqueous fluid,

a non-delayed alkaline buffer in an amount from about 1 PPTG to about 40 PPTG of the aqueous fluid, and

an alpha-hydroxycarboxylic acid gelation delaying agent in an amount from about 0.25 PPTG to about 3.75 PPTG of the aqueous fluid, and

a zirconium (IV) crosslinking agent in an amount from about 0.1 PPTG to about 5 PPTG of the polymer solution;

pumping the fracturing fluid into the subterranean zone via the wellbore;
permitting the fracturing fluid to gel after having substantially traversed the well bore or
after having entered the subterranean formation, thereby causing hydraulic fracturing of the
subterranean formation.

Claim 41 (original): The method according to claim 41, further comprising the steps of:

adding proppants to the fracturing fluid; and
utilizing the fracturing fluid to disperse the proppants throughout the subterranean
formation.

Claim 42 (original): The method according to claim 40, further comprising the step of adding a breaker
to the fracturing fluid to permit the removal of the fracturing fluid from the subterranean formation.

Claim 43 (original): The method according to claim 40, wherein the aqueous fluid comprises
substantially any aqueous fluid that does not adversely react with one of the constituents of the fracturing
fluid, the subterranean formation, and the fluids present therein.

Claim 44 (original): The method according to claim 40, wherein the aqueous fluid is selected from the
group consisting of fresh water, natural brines, and artificial brines.

Claim 45 (original): The method according to claim 44, wherein the artificial brines are selected from the
group consisting of such as potassium chloride solutions and sodium chlorides solutions.

Claim 46 (original): The method according to claim 40, wherein the stabilizer comprises any free-
radical-scavenging compound.

Claim 47 (original): The method according to claim 40, wherein the stabilizer is selected from the group
consisting of sodium thiosulfate, thiourea, urea, sodium sulfite, and methanol.

Claim 48 (currently amended): The method according to claim 40, wherein the non-delayed alkaline
buffer comprises alkaline compounds.

Claim 49 (original): The method according to claim 48, wherein the alkaline compounds comprise one or more selected from the group consisting of ammonium and alkaline metal hydroxides, carbonates, and bicarbonates.

Claim 50 (original): The method according to claim 48, wherein the alkaline compounds are selected from the group consisting of sodium hydroxide, sodium carbonate, and sodium bicarbonate, and mixtures thereof.

Claim 51 (currently amended): The method according to claim 40, wherein the alpha-hydroxycarboxylic acid gelation delaying agent comprises an alpha-hydroxycarboxylic acid, the salt of an alpha-hydroxycarboxylic acid, or mixtures thereof.

Claim 52 (original): The method according to claim 51, wherein the alpha-hydroxycarboxylic acid or alpha-hydroxycarboxylic acid salt is selected from the group consisting of citric acid, malic acid, glycolic acid, lactic acid, tartaric acid, gluconic acid, glyceric acid, mandelic acid, their salts and mixtures thereof.

Claim 53 (currently amended): The method according to claim 40, wherein the alpha-hydroxycarboxylic acid gelation delaying agent comprises an ammonium, amine, or alkali metal salt of an alpha-hydroxycarboxylic acid.

Claim 54 (original): The method according to claim 40, wherein the ammonium, amine, or alkali metal salt of an alpha-hydroxycarboxylic acid is selected from the group consisting of sodium citrate and ammonium lactate.

Claim 55 (original): The method according to claim 40, wherein the zirconium (IV) crosslinking agent comprises any zirconium compound capable of solubilizing in an aqueous polymer solution to release the metal so that gelation takes place under controlled conditions.

Claim 56 (original): The method according to claim 40, wherein the zirconium (IV) crosslinking agent is selected from the group consisting of an aqueous solution of a zirconium alpha-hydroxycarboxylic acid salt.

Claim 57 (original): The method according to claim 56, wherein the zirconium alpha-hydroxycarboxylic acid salt crosslinking agent is selected from the group consisting of zirconium ammonium lactate, zirconium di or tri ethanolamine lactate, zirconium diisopropylamine lactate, and zirconium sodium lactate salts.

Claim 58 (original): The method according to claim 56, wherein the complex of zirconium and an alpha-hydroxycarboxylic acid is selected from the group consisting of aqueous solutions of zirconium citrate, zirconium tartate, and zirconium glycolate.

Claim 59 (original): The method according to claim 40, wherein the zirconium (IV) crosslinking agent is selected from the group consisting of monoalkylammonium zirconium compounds, dialkylammonium zirconium compounds, and trialkylammonium zirconium compounds.

Claim 60 (original): The method according to claim 40, wherein the zirconium (IV) crosslinking agent is selected from the group consisting of a zirconium triethanolamine complex and a diethanolamine complex.